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Relativistic Proton Instability and the Prompt to Afterglow Plateau Luminosity Ratio

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Relativistic protons, at the forward external shock of a GRB relativistic blast wave (RBW) become unstable to converting their energy dynamically into e+e- pairs through the emission of synchrotron radiation by these e+e-pairs when their column density becomes higher than a critical value given by $nR\sigma\Gamma^4 \simeq 2$ (n is the ambient density, R the shock radius, Γ the RBW Lorentz factor, σ the Bethe-Heitler cross section of the relation $p\gamma \rightarrow e + e-$). This process is enhanced if the RBW synchrotron photons are scattered upstream and re-intercepted by it. This momentum transfer can decrease Γ to 1/3 - 1/2 of its value before the RBW reaches its deceleration radius; this reduction arrests the transfer of proton energy to e+e- inducing the end of the prompt GRB phase and a severe reduction in flux by a factor $m_p/m_e \sim 2000$, followed by a plateau that extends to the time the RBW reaches its deceleration radius, when the conventional afterglow begins. We present the statistics of the prompt to plateau luminosities, to show it consistent with the predicted value m_p/m_e.

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